THERMOTRON

2800/4800 PROGRAMMER/ CONTROLLER.

TROUBLESOOTING GUIDE

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This manual has important information for the safe operation of this instrument. Read this manual carefully and tell all operators to read this manual. If you do not follow the instructions, you can cause injury or damage to the equipment, the product, and the building.

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SAFETY INSTRUCTIONS

For the safe operation of this instrument, read and follow all warnings and cautions.

WARNING: If you do not follow the instructions in a **WARNING**, injury can occur to you or to other personnel.

CAUTION: If you do not follow the instruction in a **CAUTION**, damage can occur to the equipment.

1. You must have training in the operation of this instrument before using it. Read the Operator's manual.
2. Do not operate this instrument unless it is completely assembled.
3. Maintenance and repairs must be done by authorized personnel only. Make calibrations according to the specifications given in this manual.
4. Use a mild soap and water solution to clean the control panel of the instrument.
5. To prevent electrical shock, do not touch the transformer and terminal block TB5 on the Main board.
6. To prevent damage to the instrument, do not connect AC power to the terminal blocks on the Main board (except TB5) and Multi-Option board.
7. Always use an electrical supply system with a separate electrical ground conductor. For maximum protection against electrical shock, use a circuit that is protected by a ground fault circuit interrupter.
8. This instrument is designed to use specific voltage, amperage and phasing. Under or over powering the instrument will cause premature failures and will void certain aspects of the warranty.
9. Alway remove power from the instrument before attempting to remove any circuit board or component/
10. Follow appropriate protection procedures to ensure that electrostatic charges do not cause damage to the circuit boards. Refer to section III for more details on electrostatic protection procedures.

SPECIFICATIONS

OPERATING TEMPERATURE:	$0^{O}C$ to $50^{O}C$ ($32^{O}F$ to $122^{O}F$)
POWER REQUIREMENTS:	117 volts AC ±10%, 50/60 Hertz, 23.3 volts amperes.
CHANNELS:	One or two independently programmable channels.
TEMPERATURE RANGE:	$-87^{O}C$ to $190^{O}C$ ($-125^{O}F$ to $375^{O}F$).
HUMIDITY RANGE:	20% to 100% relative humidity.
INPUT:	Type "T" thermocouple (copper/constantan).
SAMPLING RATE:	Process sampled every 0.1 sec. Control outputs updated every 1 second.
MEASURING ACCURACY:	±.25% of span typical.
TEMPERATURE SCALE:	Celsius or Fahrenheit.
DISPLAY RESOLUTION:	Temp. Selectable of 0.1^{O} or 1^{O} Celsius or Fahrenheit, 1% relative humidity.
CONTROL METHOD:	Direct digital control, heat only or heat/cool as required by chamber design.
PROPORTIONAL BAND:	Programmable 1 to 1000 units.
INTEGRAL TIME (Automatic Reset):	Programmable 1 to 1000 seconds or off (0).
OUTPUTS:	Time proportioning self-adjusting, analog 0-5 volts.
MACHINERY CYCLE TIME:	Software controlled.
AUXILIARY COOLING OUTPUT:	Programmable, 0 to 100% of 5 second time frame (channel 1 only).
ALARM OUTPUTS:	Programmable, one process or one deviation for each channel, ON/OFF TTL compatible. The alpha display flashes.
EVENTS OUTPUTS:	4 ON/OFF TTL compatible. Independently programmable for each interval, or manually.
INTERVALS:	Up to 256 intervals may be stored in memory.
INTERVAL LENGTH:	1 minute to 24 hours. 1 minute resolution.
PROGRAMS:	Up to 10. Intervals can be divided between programs.
LOOPS:	Up to 16 loops per program. Each loop may be repeated 255 times, nesting allowed.

PROGRAM MEMORY:	RAM. Dynamically allocated by program number up to maximum number of intervals. Lithium battery back-up to 7 years without power. Battery shelf life 10 years.
COLD JUNCTION COMPENSATION:	Temperature stability $\pm 0.025^{\circ}C/^{\circ}C$ ambient change.
OPEN THERMOCOUPLE PROTECTION:	Deactivates all outputs. The alpha display shows "OPEN T/C".
OPTIONAL ACCESSORIES:	Multi-Option Board -Real-time clock -Analog process variable retransmit -Printer output: RS-232 "talk only" port Computer Interface Board RS-232 or GPIB (IEEE-488, 1978 standard) Solid State Relay Board

1. INTRODUCTION

1.1 How To Use This Manual

This manual is a service guide for 2800 and 4800 Programmer/Controllers. This manual is intended to be used with the Programmer/Controllers Operator's Manual.

The following section, Functional Description, describes the overall system and each card. Section three describes troubleshooting symptoms and procedures. The Appendixes provide information on diagnostic tests, test points, terminal block definitions, Relay board assignments, stop codes, configuration, electrical Noise and Immunization procedures, common computer I/O problems and questions, board replacement procedures and computer part numbers.

Always check the programming set-up on your instrument before beginning or carrying out any hardware repairs. Refer to the programming instructions in the Operator's Manual.

2. FUNCTIONAL DESCRIPTION

The 2800 and 4800 Programmer/Controller systems are similar but have subtle differences. This manual describes the similarities and differences, functions, troubleshooting symptoms, and card replacement procedures. Each system consist of several printed circuit boards (PCB). These PCBs are identified below.

Most 2800/4800 Main Boards are mounted on an aluminum mounting plate. This plate attaches to the instrument housing on the chamber console. The Function Board (4800 only), Multi-Option Board, and Computer I/O Option Board mount piggy-back style on the Main Board. Remote mounting of the Display Head provides easier user access. Remote mounting of the Relay Board(s) provide easier connection to the 115 Volt AC control circuitry. Refer to Figure 1 for the Overall Layout Diagram.

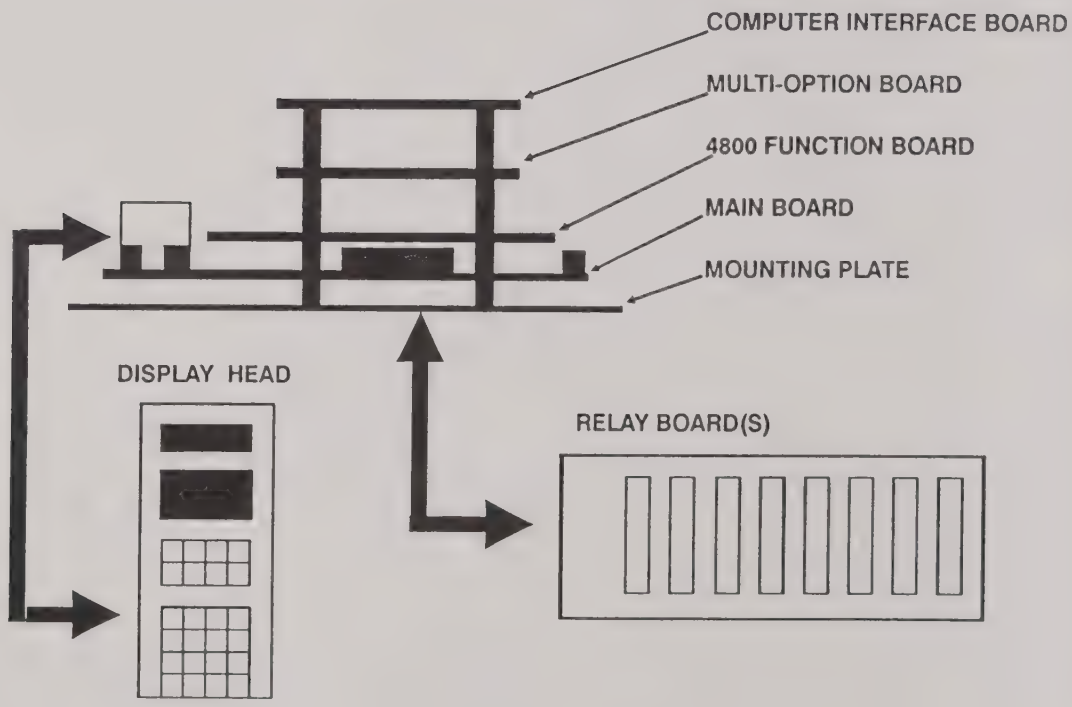

Figure 1 Overall Layout Diagram

2.1 MAIN BOARD

2.1.1 How to Identify

There are three versions of the Main Board. Throughout this manual, they are referred to as the 2800 Main Board, 2800/4800 Main Board Version I, and 2800/4800 Version II. Refer to Figure 2a, 2b and 2c as you read thru the descriptions of these board.

All three versions have two common features. The first feature is a long terminal block (TB2) located along one edge of the PCB assembly. On the 2800 version, TB2 contains 16 terminals. On the 2800/4800 Versions I and II, TB2 contains 18 terminals. The second feature is a transformer (T1) in the lower right hand corner of the board. In both systems, the Main Board is mounted on an aluminum mounting plate (refer to Figure 1). This mounting plate prevents the boards from flexing and provides the means to mount the Programmer/Controller on the chamber. The Main Board can be either a one or two channel version. To identify if the Main Board is a two channel version, look for the Input Amplifier U9. If U9 is present on the board, it is a two-channel version.

2.1.2 Functional Description

The Main Board provides six major functions. The following paragraphs describe these functions.

- Power Supply Function.
- The Main Board provides the required voltages to the other boards within the system.
- Micro-computer Function.

The Main Board contains the brains of the system. The micro-processor executes PROM, EEPROM and RAM data. The PROM stores the firmware program. The EEPROM stores the configuration data. The RAM stores the users program data.

Thermocouple Input Function — The Main Board provides signal conditioning, ambient junction compensation and analog-to-digital conversions. These items are required to read the temperature at the measuring junction of the thermocouple(s).

Control Output Function (2800 only) — The Main Board provides the signals required to energize the controlling elements of the chamber. These signals provide the heat/humidity pulses needed to achieve and maintain the identified set point. These signals are also applied to the Display Head Channel 1 and Channel 2 LEDs.

Auxiliary and Miscellaneous Input/Output Functions — The Main Board provides signals that energize the Auxiliary, System Enable, Machinery Enable and Alarm relays.

Display Head Interface Function — The Main Board provides signals required to send and receive information to and from the Display Head.

2.1.3 Identified Components

NOTE Items in Parentheses() are found on the 2800/4800 Version II Main Board only.

TP 1-11 — These test points (TP) are on all versions of the Main Board. Refer to Appendix B for the test point descriptions.

TP 12-20 — These test points are on the Main Board Version II only. Refer to Appendix B for the test point descriptions.

U9	This is the Input Amplifier for channel two. This component is only on two channel units.
TB 1	This terminal block connects the thermocouple(s) to the Main Board. The Ambient Junction Compensator is located inside this terminal block. Refer to Appendix C for the individual terminal descriptions.
TB 2	This terminal block connects the Main Board control signals to the chamber system. Refer to Appendix C for the individual terminal descriptions.
TB 3	This terminal block connects the channel 1 heat pulse signal to the Relay Board. Refer to Appendix C for the individual terminal descriptions.
TB 4	This terminal block connects the channel 2 heat pulse signal to the Relay Board. Refer to Appendix C for the individual terminal descriptions.
TB 5	This terminal block connects the 115 VAC to the Main Board.
J1	This DB-25 Connector connects the Display Head to the Main Board.
J2	This connector connects the Computer I/O Option Board to the Main Board.
J3	This connector is on the 2800/4800 Version Main Board only. It connects the Main Board to the Chamber system.
J4	This connector connects unregulated power from the Main Board to the 4800 Function Board. It is in 4800 systems only.
B1	This is the memory back-up power battery.
T1	This is the step-down transformer, which steps the incoming 115 VAC down to working voltages.
W3,(W1)	This jumper selects the interlock control output mode. In the LOCK or 2nd position, channel 1's time proportioning output (heat) takes precedence over channel 2's output (humidity).
(LED 1)	This LED indicates the operation of the Main Board Computer circuitry. It pulses at a fairly constant rate (with varying intensities) during normal operation.
(F1, F2)	These are the power supply fuses in the 115 VAC input circuit. They protect the Main Board from over-voltage input.
(F3)	This fuse protects the 5 Volt Power Supply from over-current conditions. On some Version II boards, this fuse may be labeled RS1 or RS2.

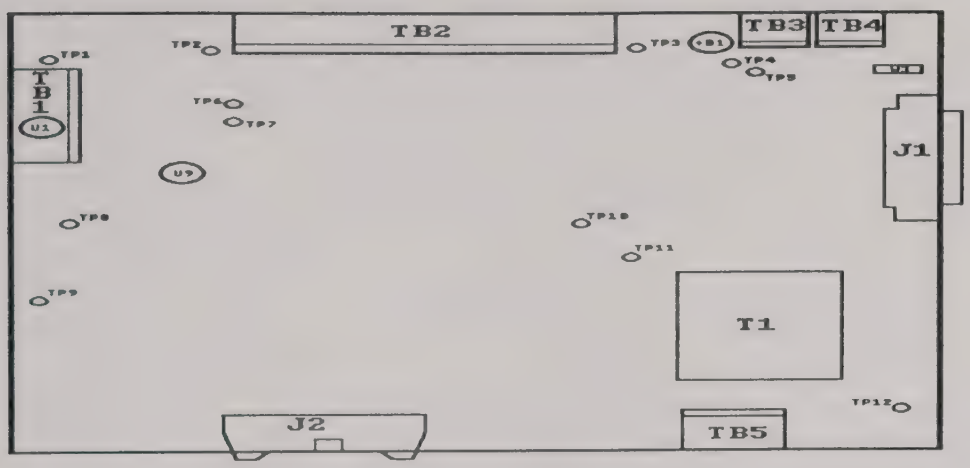

FIGURE 2a 2800 MAIN BOARD

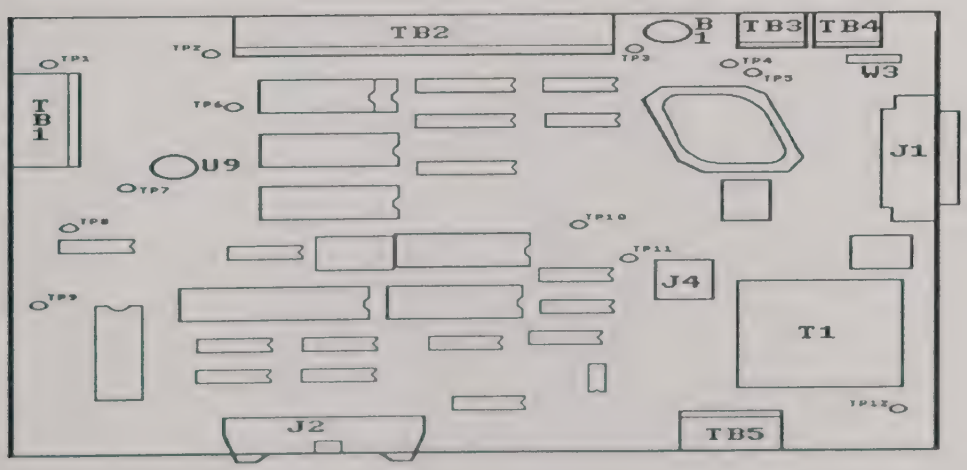

FIGURE 2b 2800/4800 MAIN BOARD VERSION I

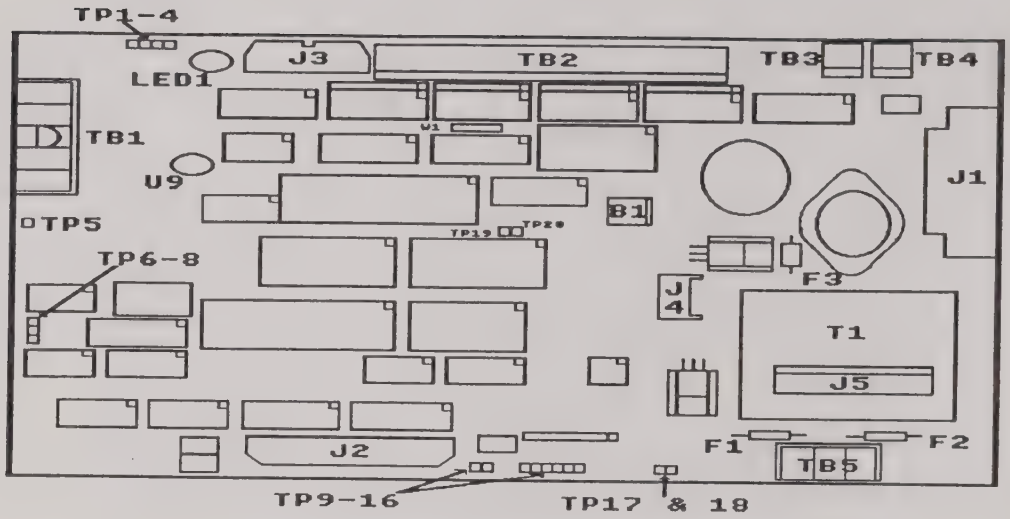

FIGURE 2c 2800/4800 MAIN BOARD VERSION II

2.2 Display Head

2.2.1 How To Identify

There are three versions of the Display Head. Throughout this manual, they are referred to as Version I, II, and II. Version I was a surface mount type. Version II and III are flush mount types. Refer to Figure 3a thru 3c0 as you read thru the description of the Display Head.

The Display Head consists of a Vacuum Florescent Display, Status LEDs, a keyboard connector and the Main Board Interface cable connector.

2.2.2 Functional Description

The Display Head provides the user interface functions for the 2800/4800 system. The following paragraphs describe these functions.

Data Display Function

The Display Head contains two vacuum Florescent displays and their drivers. The upper display is a 10 character, 14 segment, alpha numeric display. The lower display is a 4 character, 7 segment, numeric display. The upper display is used to operate the system and identify data displayed on the lower display. The lower display shows numeric data.

Status Display Function

The Display Head contains ten LED's. These LED display the current operating status of the system. Eight of these LED's are located behind the function keys. They are normally lit when the associated function is active. The remaining two LED's are identified as the Channel 1 and Channel 2 control output status LEDs. They indicate the control action of the associated channel.

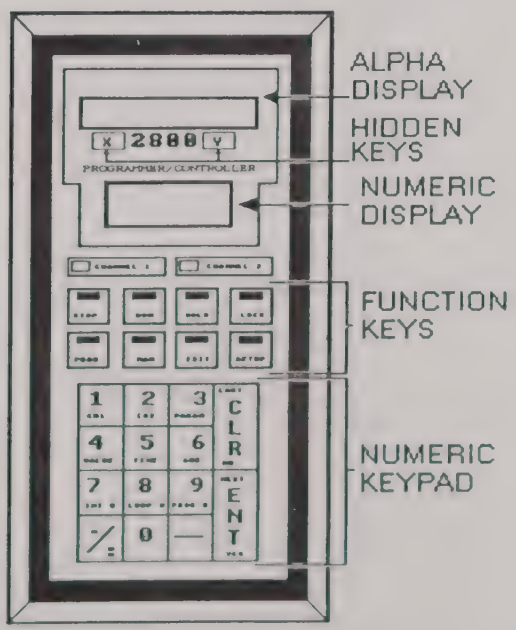

FIGURE 3a 2800/4800 FRONT PANEL

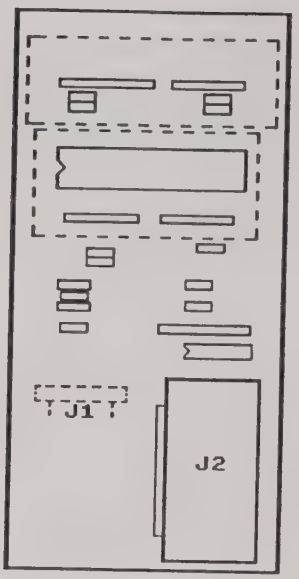

FIGURE 3b 2800/4800 DISPLAY HEAD VERSION I & II

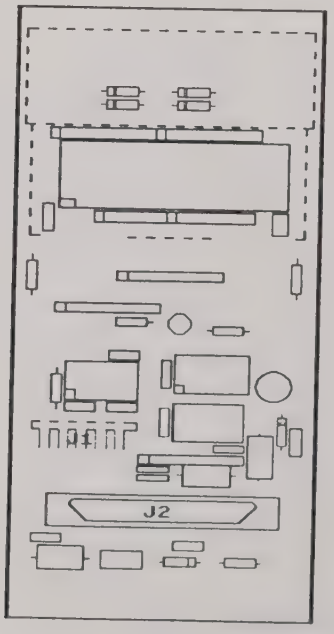

FIGURE 3c 2800/4800 DISPLAY HEAD VERSION III

2.3 4800 Function Board

2.3.1 How To Identify

There are two versions of the Function Board. One version contains an Analog-to-Digital Converter (U21). The other version does not. Refer to Figure 4 as you read thru the description of the Function Board.

2.3.2 Functional Description

The Function Board provides six functions for the 2800/4800 system. The following paragraphs describe these functions.

Control Outputs Function

The Function Board provides five control output functions. They are:

- two stages of heating,
- two stages of cooling plus bypass,
- machinery time out signals for channels 1 and 2,
- process alarm outputs for channels 1, 2, and 3,
- and deviation alarm outputs for channels 1, 2, and 3.

Auxiliary and System Event Outputs Function

The Function Board provides outputs for Auxiliary Events Groups 2 and 3, and System Events 1 thru 5.

Remote Control Inputs Function

The Function Board provides five remote control inputs. These inputs are RUN, STOP, HOLD, RESTART, and PRINT TRIGGER. These same inputs can also be used to get the System Monitor status if installed.

Remote Program Storage

The Function Board contains a Zero Insertion Force (ZIF) socket (U1). This socket is used to save, load and/or transfer user profiles from/to an EEPROM. POWER MUST BE REMOVED FROM THE 4800 WHEN THIS FUNCTION IS USED. The socket can also be used to connect the remote EEPROM programming assembly.

Analog Input and Conversion Function (used on boards with an A-to-D Converter)

The Function Board provides analog-to-digital conversion. When any type of electronic sensor, except a thermocouple, is used the Function Board receives an analog signal and converts it to a digital signal. This signal is applied to channel 2 and 3 respectively.

Analog Output Function (used on boards with an A-to-D Converter).

The Function Board provides analog signal to external controlling or recording devices such as transducers (controlling devices) or recorders (chart recorder).

2.3.3 Identified Components.

TP1-2 — These test points (TP) are on both of the Function Boards. Refer to Appendix B for the test point descriptions.

J1 — This connector provides the path for the Auxiliary Outputs Groups 2 and 3 from the Relay Board.

J2	This connector provides the path for the System Events Outputs and Channel 3 Alarm Outputs from the Relay Board
J3	This connector provides the path for Channel 1 Control and Alarm Outputs from the Relay Board
J4	This connector provides the path for Channel 2 Control and Alarm Outputs from the Relay Board.
J5	This connector connects the Function Board to the Main Board.
J6	This connector connects the Main Board 5 Volt unregulated power to the function Board.
TB1	This terminal block connects the remote control inputs to chamber devices. (Refer to Appendix C.)
TB2, TB3	These terminal blocks connect the Function Board Analog Outputs to external controlling or recording devices.
TB4	This terminal block connects the analog inputs from the sensing devices to the Function Board.
U1	This is the ZIF socket which holds a program storage EEPROM or the cable to a remote EEPROM programming assembly.
U21	This is the Analog-to-Digital Converter found on some Function Boards.
RN2	This is a Range Programming Resistor Box for the Function Board analog inputs. It is needed whenever U21 is installed.
W1, W2	These jumpers select either Voltage (V position) or Current (I position) for the analog outputs
W3, W4	These jumpers select the polarity of the analog inputs. They are normally in position 1.

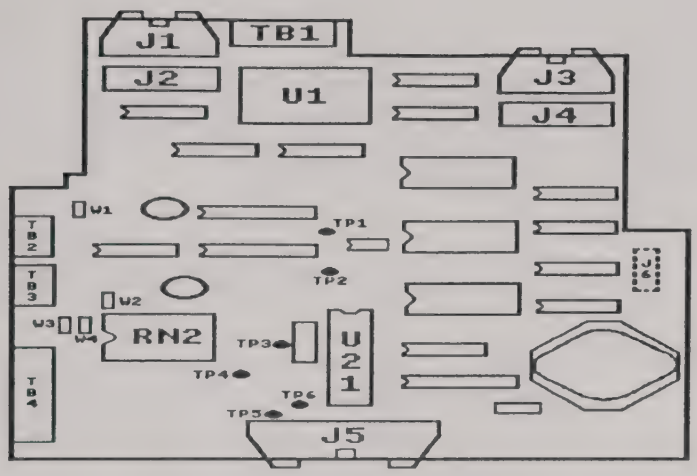

FIGURE 4 4800 FUNCTION BOARD

2.4 Multi-Option Board

2.4.1 How To Identify

There are two versions of the Multi-Option Board. Throughout this manual, they are referred to as Version I and II. Refer to Figure 5a and 5b as you read thru the description of the Multi-Option Baord.On the Version I board, the battery is located to the right of the J2 connector in the lower right-hand corner. On Version II, the battery is located to the right of TB2 in the upper right-hand corner.

2.4.2 Functional Description

The Multi Option Board provides three functions for the 2800/4800 system. The following paragraphs describe these functions.

Real Time Clock Function — This function provides time keeping capabilities. It is used for delayed starting, and/or the time stamp for the printer interface data logging function.

Printer Interface Function — This function provides the 2800/4800 with the capability to send data to an external printer using an RS-232 interface.

Analog Output Function — This function provides two voltage only analog outputs (Analog output 1 & 2) to the 2800/4800 system. In a 2800 system, these voltages provide the process variable re-transmit signals for channel one and channel two respectively (typically to a recorder). In a 4800 system, these outputs may be configured to convert any one of the available channel related variables to an analog signal.

2.4.3 Identified Components

NOTE Items in Parentheses() are on the Version II Multi-Option Board only.

TP1(2-4): These test points (TP) are on the Multi-Option Board. Refer to Appendix B for the test point descriptions.

TB1-2: These terminal blocks connect analog outputs 2 and 1 (respectively) from the Multi-Option Board. See Appendix C.

J1: This connector provides connection capabilities to an optional printer.

J2 (P1): This connector connects the Multi-Option Board to the Main Board.

B1: This is the battery which provides power to the real time clock circuitry during power outages.

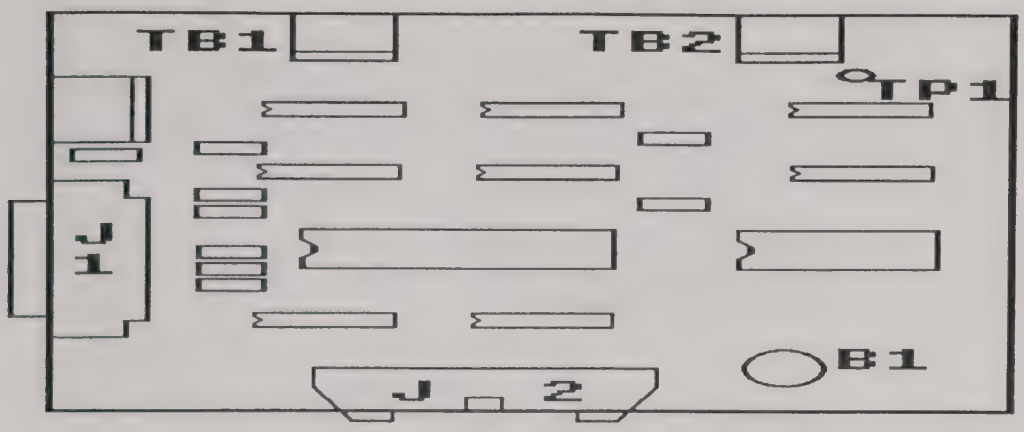

FIGURE 5a MULTI-OPTION BOARD VERSION I

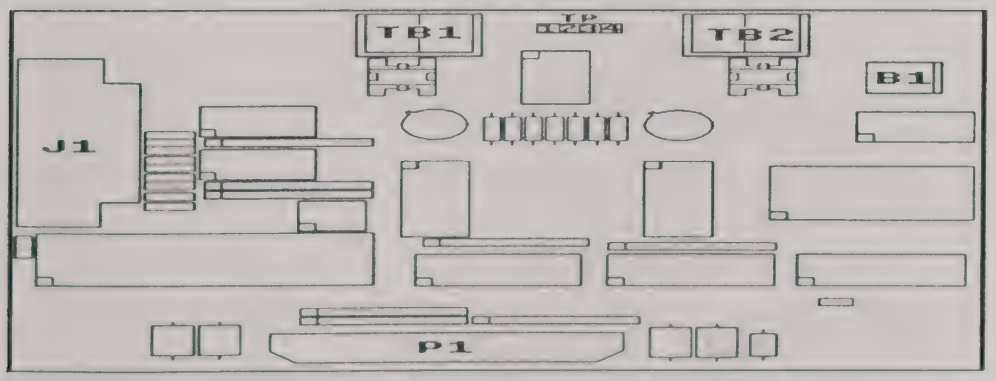

FIGURE 5b MULTI-OPTION BOARD VERSION II

2.5 COMPUTER I/O OPTION BOARD (GPIB or RS-232)

2.5.1 How to Identify

This board is optional on both the 2800 and 4800 systems. It may provide either GPIB or RS-232 communication capability, but not both. Only one Computer I/O Option Board can be installed in the system. There are three versions of the Computer I/O Option Board. Throughout this manual, they are referred to as the Version I(A), Version I(B), and Version II. Refer to Figure 6a, 6b, and 6c as you read thru the descriptions of this board.

The Computer I/O Option Board is identifiable by the presence of a 8-position DIP switch and 10-segment LED bar graph display. The Version I boards are identical. The Version II assembly is identifiable by the aluminum shield surrounding the interface connector.

2.5.2 Functional Description

The Computer I/O Option Board provides three major functions. The following paragraphs describe these functions.

Interface Parameter Selection Function — The 8-position DIP switch settings select the required interface parameters. These include the Device Address for GPIB use, and the Serial format (baud etc.), for RS-232 use. See the Operator's Manual for setting this switch.

Interface Status Display Function — The 10-segment LED bar graph display provides visual indications of the interface status. This is useful in computer interface troubleshooting between the 2800/4800 system and a remote computer. See the Operator's Manual for the definitions of these LED's.

Computer I/O Option Function: — The GPIB or RS-232 assembly contains the necessary hardware to perform the required interface functions. These include data transmission and receiving, handshaking, and others.

2.5.3 Identified Components

NOTE Items in parentheses are on the Version II Computer I/O Option Board only.

J1: This is a standard female DB-25S connector and connects the 2800/4800 system RS-232 interface to the Host Computer.

J2: This standard GPIB (IEEE-488) connector connects the 2800/4800 system interface to the Host Computer.

J3: This connector connects the Computer I/O Option Board to the Main Board.

L1 (DS1): This 10-segment bar graph display indicates the status of the 2800/4800 system Computer I/O Option.

SW1: This 8-position DIP switch selects the required interface parameters.

(W1): This jumper (Version II only) selects either RS-232 or RS-485 signal levels and protocols on the Serial interface assembly.

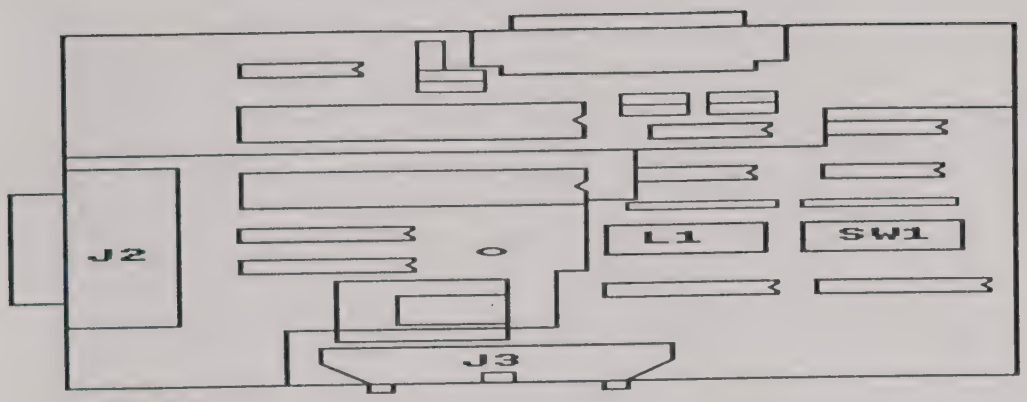

FIGURE 6a GPIB OPTION BOARD VERSION I A & B

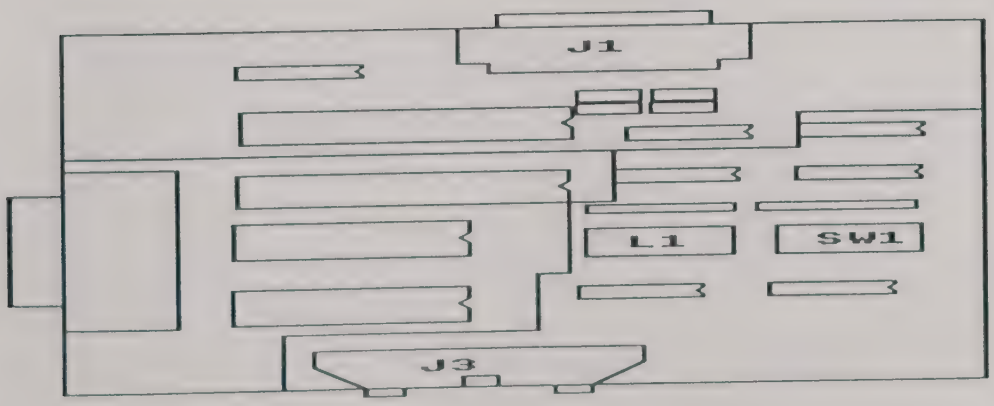

FIGURE 6b RS-232 OPTION BOARD VERSION I A & B

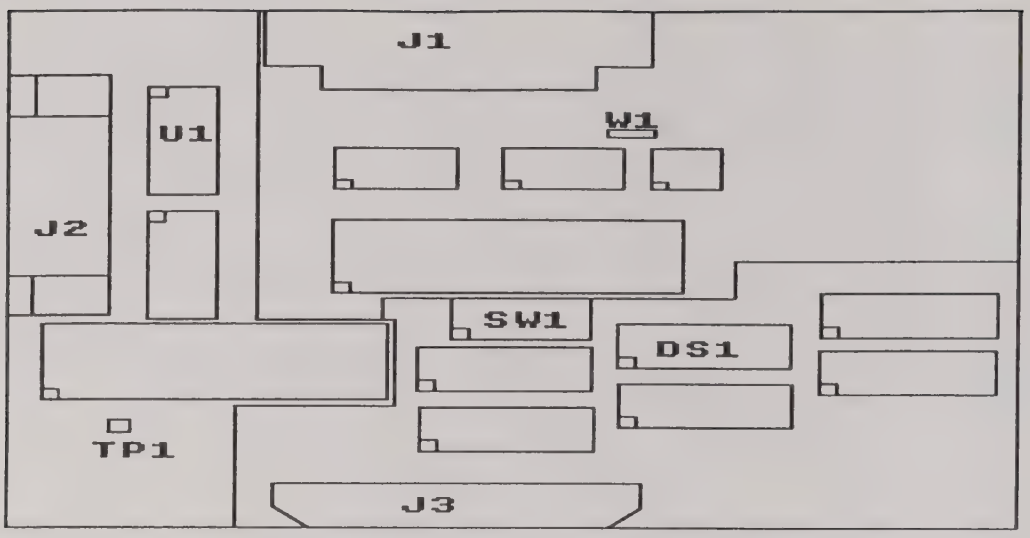

FIGURE 6c GPIB OPTION BOARD VERSION II

3. TROUBLESHOOTING PROCEDURES

3.1 General Information

In order to efficiently troubleshoot the 2800/4800 system, you should familiarize yourself with the various hardware assemblies that make up the 2800/4800 system by reviewing the Figures and Descriptions if you haven't already done so. By having a general understanding of how these hardware assemblies look and fit together, you can more easily locate those assemblies when it is referred to in the troubleshooting symptom/solution step. In addition, the following steps should be taken EVERY time you attempt to trouble shoot the 2800/4800 system.

1. Go to the section of this manual entitled "Preliminary Troubleshooting Steps" FIRST! Some problems can be solved right away by doing these checks before any other troubleshooting is attempted.

2. Go to the "2800/4800 Miscellaneous Symptoms" section next. Look though the symptoms that are listed there to see if any of them match the problem you are seeing. If so, follow the directions given in that section.

3. If your symptom(s) still remain, go to the "2800/4800 Symptoms/Solutions" chart and locate the symptom which most closely describes the problem you are experiencing.

4. Try the solution(s) listed for the symptom you've chosen. If there is more than one solution, try them in the order they are listed and re-evaluate your problem after each solution step. Stop troubleshooting as soon as you've found the problem since you will usually solve the problem before you complete all of the solution steps. Be sure and do exactly what the instructions specify or you may miss the solution to the problem completely! If you determine which board was the cause of the failure, reinstall all other original boards you had exchanged during the troubleshooting process. See Appendix H for board replacement procedures.

5. If all of the applicable solution steps fail to solve the problem, coordinate with Thermotron Product Support for returning the 2800/4800 system to Thermotron.

REMEMBER: You can only troubleshoot a 2800/4800 system down to the board level. Do not attempt to repair or replace any components on the boards themselves, unless a particular solution step specifically instructs you to do so. If you run into problems that are not explained in this manual, contact Thermotron Product Support for further assistance.

IMPORTANT: Always remove power from 2800/4800 system when connecting / disconnecting cables, boards, etc. Employ ESD protection measures when working with the 2800/4800 system to prevent damage to the electronics thru static discharge.

BEFORE you call Thermotron, be sure you have filled out the 2800/4800 TROUBLESHOOTING LOG SHEET.

3.2 PRELIMINARY TROUBLESHOOTING STEPS

There are certain steps which should be taken before any 2800/4800 troubleshooting is begun. This will get you to a known starting condition from which to begin your troubleshooting. Following these steps may actually solve your problem, without the need for further troubleshooting.

1. Ensure that the 2800/4800 is supplied with a constant 115 Volt AC (10%), 50 or 60 Hertz power supply. This may be checked on the power terminal block on the Main Board.

2. Cycle power to the 2800/4800 system.

3. Inspect all terminals and cable connectors for proper connections.

4. Perform all tests found in the diagnostics section of this manual relevant to your system configuration. See Appendix A.

5. Verify correct parameters at all test points identified in Appendix B.

3.3 2800/4800 TROUBLESHOOTING LOG SHEET

LOG THE FOLLOWING DATA BEFORE CALLING
THERMOTRON PRODUCT SUPPORT

1. List all symptoms:

2. List results of Diagnostics tests: (See Appendix A)

   Software Version:

3. Identify and List all options boards:

4. Computer Interface Board: GPIB RS-232
   Was it in use at the time of the failure.

5. Customers Name:

6. Chamber Serial Number:

3.4 2800/4800 Miscellaneous Symptoms

Following is a list of symptoms which may appear in the 2800/4800 system. The solution for any of these symptoms will be to replace the Main Board. The symptoms are listed by the effected function.

Function	Symptom
Analog Input	4800 goes into stop if analog input is momentarily over range.
Analog Outputs	%RH Re-transmit analog output does not shut off when running temperature only profiles.
Auxiliary Events	Auxiliary group #1 would shut down for a fraction of a second approximately every 15 minutes.
	Auxiliary group #2 would be disabled during programming.
Control Outputs	Incorrect channel two time proportioning outputs when channel two is configured for Heat Only control. Intermittent loss of heat control time proportioning pulse.
Delayed Start	It is not possible to cancel a delayed start once it has been programmed.
GPIB Interface	Time delay required between Write and Read operation when very fast host computer is used. 2800/4800 system would reset to the STOP mode during frequent GPIB communications with a fast host computer.
Machinery Control	2800/4800 configured for heat only fails to shut off the refrigeration machinery during a 100% heat demand cycle.
RS-232 Interface	Missing data when 2800/4800 send information to remote host computer.

3.5 2800/4800 TROUBLESHOOTING CHART

SYMPTOM	SOLUTION(S)
1. Alpha and Numberic Displays: Displays are blank or show 'garbage'.	1. Cycle power to instrument. 2 Perform Display test diagnostics. If step 1 or 2 corrects the problem, read and apply the information found in Appendix F, "Noise Immunization Procedures". 3. Check Display Head to Main Board cable and connections. 4. Isolate Main Board and Display Head by disconnecting all option boards. Apply power and check for correct operation. 5. Exchange Display Head. 6 Exchange Main Board.
2. Status LED's: LED's all on, all off, or not indicating correct status.	1. Follow steps under #1 above.
3. Keyboard: Some or all of the keys do not work.	1. Perform key test diagnostic, see Appendix A. 2. Check remote key lock if installed. Disconnect wire from Main Board TB2-14 and try keyboard again. 3. Follow steps under symptom #1 above.
4. T/C Input: Error in temperature or humidity reading.	1. Follow calibration procedure in users manual. 2. Check configuration. See Appendix E. 3. Exchange Main Board.
5. T/C Input: Alpha display shows: OPEN T/C	1. Check for actual open thermocouple by shorting input terminals with a short jumper wire. 2. Follow steps found under symptom #4 above.

SYMPTOM	SOLUTION(S)
6. T/C Input: Reading Drifts with ambient temperature or time. 'Loses calibration'	1. Re-calibrate T/C input(s) and check for drift. 2. Exchange Main Board.
7. 2800 Control Outputs: Missing or incorrect heat and/or humidity outputs from Main Board.	1. Use Manual Throttle mode to call for 50% heat or humidity demand. See Appendix A. 2. Monitor voltage on TB3-1 and/or TB4-1 for pulses greater than 3 Volts DC. 3. If Voltage pulses are present, check external circuitry. 4. Exchange Main Board if pulses do not appear.
8. Main Board Outputs: Some or all of the Main Board output signals do not work.	1. Operate 2800/4800 such that output in question should be on. Ex.: Program with Aux 1 on. 2. Monitor the output terminal in question on TB2 for a voltage greater than 3 Volts DC. 3. If signal voltage is present, check external circuitry. 4. Exchange Main Board if required signal does not appear.
9. 4800 Control Outputs: Missing or incorrect channel 1 and/or channel 2 outputs from 4800 Function Board.	1. Use Manual Throttle mode to call activate output in question. See Appendix A. 2. Monitor voltage on Relay board TB1 which corresponds to the output in question for pulses greater than 3 Volts DC. 3. If Voltage pulses are present, check external circuitry, SSR's, etc. 4. Check cable connections between 4800 Function Board and Relay Board(s). 5. Exchange 4800 Function Board. 6. Exchange Main Board.

SYMPTOM	SOLUTION
10. 4800 Misc Outputs: Some or all of the misc outputs from 4800 Function Board do not work.	1. Operate 4800 such that output in question should be on. Ex.: Program with Aux 2-1 on. 2. Monitor voltage on Relay board TB1 which corresponds to the output in question for signal greater than 3 Volts DC. 3. If Voltage is present, check external circuitry. 4. Check cable connections between 4800 Function Board and Relay Board(s). 5. Exchange 4800 Function Board. 6. Exchange Main Board.
11. 4800 Analog Inputs: Alpha display shows: OPEN AIN -OR- Error in Analog input variable	1. Calibrate using procedure in users manual. 2. Check configuration. See Appendix E. 3. Exchange 4800 Function Board. 4. Exchange Main Board.
12. 4800 Analog Output: Output from 4800 Function Board not correct.	1. Check for output on appropriate terminal block. See Appendix C. 2. Calibrate using procedure in users manual. 3. Check configuration. See Appendix E. 4. Check Jumpers W1 and W2 for correct selection, voltage or current output. 5. Exchange 4800 Function Board.
13. 4800 Remote Inputs: Inputs not working correctly.	1. Use a jumper from 4800 Function Board terminal TB1-6 (COM), to the input in question to activate the input. 2. If Input works using jumper, check external wiring. 3. Exchange 4800 Function Board.

SYMPTOM	SOLUTION
14. 4800 Program EEROM: Not able to save/load programs on remote EEROM.	1. Exchange EEROM. 2. If problem is in the loading of and EEROM program from a different 4800, ensure that both 4800's are same configuration. 3. If external EEROM assembly is installed, disconnect cable from ZIF socket U1 and install EEROM directly into socket U1 in its place. If function now working, problem is in external EEROM board and/or interconnect cable. 4. Exchange 4800 Function Board.
15. Multi-Option Analog Outputs: Analog output from Multi-Option board not correct.	1. Check for output on appropriate terminal block. See Appendix C. 2. Calibrate using procedure in users manual. 3. Check configuration. See Appendix E. 4. Exchange Multi-Option board.
16. Real Time Clock: RTC loses time.	1. Check voltage across battery B1 on Multi-Option board with power removed from system. Voltage should be greater than 2.8 Volts DC. 2. Exchange Multi-Option board. 3. Exchange Main Board.
17. Real Time Clock: RTC gains time.	1. Exchange Multi-Option board.}
18. Real time Clock: Can not set RTC.	1. Check cable/connections of the option board interface. Exchange Multi-Option board.

SYMPTOM	SOLUTION
19. Printer Interface: Printer not printing data. -OR- Printer missing some data.	1. Verify setting of Print Int Time parameter to a non-zero value. 2. Ensure that printer is powered, and has paper supply. 3. Check cable and connections from 2800/4800 to printer. 4. Exchange printer or if an RS-232 terminal is available, configure it using the 2800/4800 RS-232 parameters, connect to Multi-Option board connector J1, and observe terminal CRT for data from printer. 5. Exchange Multi-Option board. 6. Exchange Main Board.
20. Computer Interface: Will not communicate with host computer.	1. Refer to Appendix G for common questions and problems with computer interfacing. 2. Use the bar graph LED's on the Computer Interface board as a debugging tool. See the users manual for a description of each LED. 3. Substitute a 'dumb' terminal for the RS-232 'host' computer. 4. Use a bus analyzer to debug the GPIB interface. 5. Exchange Computer Interface board. 6. Exchange Main Board.
21. Miscellaneous: System goes into stop.	1. Examine STOP CODE, see Appendix D. If stop code is '1', and key was not pressed, then exchange Display Head. 2. If stop code is not '1' then track fault as indicated by stop code. See Appendix D. 3. If not identified, exchange Main Board.
22. Miscellaneous: Inconsistent, undocumented ro incorrect operation.	1. Cycle Power to the 2800/4800. 2. Perform RAM and ROM diagnostic tests. See Appendix A. 3. Exchange Main Board.

A. APPENDIX A - DIAGNOSTIC TESTS

A.1 Manual Reset

Some of the following tests require the use of the Manual Reset function. The following procedure is used to perform a Manual Reset:

1. Press the **CLR** and **STOP** keys at the same time.
2. The alpha and numeric displays will go blank, and all the status LED's will light up. The 2800/4800 is now in the Reset condition.
3. The 2800/4800 will remain in the Reset condition for approximately 1 to 2 seconds. If one of the following diagnostic tests instruct the user to press another key during this time, quickly release the **CLR** and **STOP** keys and press the required diagnostic key.

A.2 RAM Test

The RAM test provides a diagnostic test of the RAM device on the 2800/4800 Main Board. This test is also be used to clear and initialize the 2800/4800 memory.

CAUTION:

The user programs are erased during the RAM Test.

1. Perform the Manual Reset as described in paragraph A.1.
2. While the 2800/4800 is in the reset condition, press and hold the hidden **X** key.
3. For approximately 2 seconds, the 2800/4800 alpha display shows:

TSTING RAM

4. If the RAM Test passes, the 2800/4800 alpha display shows

–RAM OK–

5. If the RAM Test does not pass, the 2800/4800 will alpha display shows:

RAM FAILED

6. Press the **STOP** key to return to the normal operating mode.

A.2 ROM Test

The ROM test provide a test of the installed firmware memory. The ROM test will indicate the results of the test in the alpha and numberic displays. The ROM test is only valid on 2800/4800 Version II Main Boards.

1. Perform the Manual Reset described in paragraph A.1.
2. While the 2800/4800 is in the reset condition, press and hold the hidden **Y** key.

3. The 2800/4800 alpha display shows

TSTING ROM

   for approximately 1 second.

4. Once the ROM test is complete, the 2800/4800 alpha display shows:

CHECK SUM

   and the actual value of the check sum in the numeric display. This value should be '0' for all Version II Main Boards.

5. Press the **STOP** key to return to the normal operating mode.

A.3 Display Test

The Display test exercises all the display functions of the 2800/4800 Main Board and Display Head. This test is used to identify a malfunctioning display, and/or status LED(s).

1. Perform the Manual Reset described in paragraph A.1.
2. While the 2800/4800 is in the reset condition, press and hold the **./:** (decimal point/colon) key.
3. The alpha display scrolls thru its entire character set, which includes all uppercase letters, numbers, and some special characters.
4. The numeric display sequences thru the numbers 0 thru 9, placing each digit (except 0) in each of the four character positions.
5. The status LED's sequentially come on one at a time. The CHANNEL 1 LED comes on with the SETUP LED, and CHANNEL 2 LED comes on with the LOCK LED.
6. Press the **STOP** key to return to the normal operating mode.

A.4 Key Test

The Key test diagnostic allows the user to test the action of all the keys on the 2800/4800 Display Head.

1. Perform the Manual Reset described in paragraph A.1.
2. While the 2800/4800 is in the reset condition, press and hold the **-** (minus sign) key.
3. The 2800/4800 alpha display shows:

KEY TEST

4. Press each key (except the **STOP** key) , to test each one. The alpha display indicates the key closure.
6. Press the **STOP** key to return to the normal operating mode. (This will also test the **STOP** key.)

A.5 Software Version

The installed software version is displayed by using the following procedure. This information may be required if you must call Thermotron Product Support.

1. Perform the Manual Reset described in paragraph A.1.
2. While the 2800/4800 is in the reset condition, press and hold the **LOCK** key.
3. The 2800/4800 alpha display shows the software version in the format 'Vn-xx-yy'. Record the version number for future reference.
4. Press the **STOP** key to return to the normal operating mode.

A.6 Manual Throttle

The Manual Throttle mode of operation is useful in troubleshooting the control outputs of the 2800/4800. By using manual throttle(s), the user can specify exactly the amount of throttle or output required for testing the actual output voltage. The following procedure is used to enter the Manual Throttle mode, and to adjust the controller output throttles.

WARNING:

When the user selects Manual Throttle operation, the 2800/4800 no longer is controlling the temperature to the desired set point. It becomes the responsibility of the user to ensure that the chamber conditions do not exceed safe operating values.

1. Place the 2800/4800 in the RUN MANUAL mode by pressing the **RUN** and **MAN** keys.
2. Press the **MAN** key again. The 2800/4800 alpha display shows:

MAN THROTL

3. Press the hidden **X** key. The 2800/4800 alpha display shows:

ENABLED

   for approximately 2 seconds. The Manual Throttle mode is now enabled, however, the 2800/4800 will continue to control automatically until the throttle(s) is edited by the user as described in the following steps.
4. Use the hidden **X** key and the **CH #** key to select the throttle display for the desired channel.
5. Press the ***** key to enter the Edit mode.
6. Use the number keys to change the displayed throttle value to the desired setting. Press the **EDIT** key to enter the new value. The throttle for the selected channel is now operating in Manual Mode. The throttle(s) for unedited channels remain in automatic mode.
7. Repeat steps 4 thru 6 to change the manual throttle setting.
8. Press the **STOP** key to exit the manual throttle mode and return to the Stop mode.

B. APPENDIX B - TEST POINTS

3.1 General Description

The following table lists the test points on the 2800/4800 boards. A typical reading is given for each test point. These values may help to determine if the board in question is operating correctly.

2800/4800 Main Board (2800 only, and 2800/4800 Version I)

Test Point	Value
TP 1	Negative Reference Voltage for analog circuit. -2.5 VDC ±0.05V
TP 2	Ch. 1conditioned T/C signal (Ambient junction at 25°C.) -87°C input = 0.25 VDC ±0.02V +191°C input = 2.25 VDC ±0.08V
TP 3	+5 Volts Protected (Battery). +3.0 VDC ±0.2V Read with Power OFF
TP 4	+5 Volt Power Supply ±0.2V
TP 5	-15 Volt Power Supply ±0.45V
TP 6	+15 Volt Power Supply ±0.45V
TP 7	Ch. 2 conditioned T/C signal (Ambient junction at 25°C.) (two channel units only) -87°C input = 0.25 VDC ±0.02V +191°C input = 2.25 VDC±0.08V
TP 8	Positive Reference Voltage for analog circuit. + 2.5 Volts DC ±0.05V
TP 9	Ambient Compensator Voltage +1.2 VDC @ 25°C room temperature ±0.02V
TP 11	Common.
TP 12	Display Voltage - 23 VDC ±3.0V

2800/4800 Main Board Version II

Test Point	Value
TP 1	Ch. 1 conditioned T/C signal (Ambient junction at 25°C.) -150°C input = -2.30 VDC ±0.06V +250°C input = +2.25 VDC ±0.06V
TP 2	Ch. 2 conditioned T/C signal (Ambient junction at 25°C.) (2 channel units only) -150°C input = -2.30 VDC ±0.06V +250°C input = +2.25 VDC ±0.06V
TP 3	Reference Voltage +1.23 VDC ±0.3V
TP 4	Ambient Compensator Voltage -0.7 VDC @ 25°C room Temperature ± 0.2V
TP 5	-5 Volt Power Supply - 5.0 VDC ±0.4V
TP 11	Battery Voltage +3.0 VDC ±0.2V Read with Power OFF
TP 13	+5 Volt Power Supply +5.0 VDC ±0.2V

TP 14	-15 Volt Power Supply +15.0 VDC ±0.4V
TP 15	-15 Volt Power Supply -15.0 VDC ±0.4V
TP 16	Common

4800 Function Board

Test Point	Value
TP 1	Negative Reference Voltage -2.5 VDC±0.2V
TP 2	Positive Reference Voltage +2.5 VDC ±0.2V

Multi-Option board Version I

Test Point	Value
TP 1	Positive Reference Voltage +5.0 VDC ±0.25V

Multi-Option board Version II

Test Point	Value
TP 1	Positive Reference Voltage +5.0 VDC ±0.25 V
TP 2	Common.

C. APPENDIX C - TERMINAL BLOCK DEFINITIONS AND RELAY BOARD ASSIGNMENTS

C.1 General Description

2800 Only Main Board Terminal Block #1

Terminal	Definition
TB1-1	Channel one (+) Thermocouple, (blue) connection.
TB1-2	Channel one and two (-) Thermocouple, (red) connection.
TB1-3	Not Used (Ambient Compensator)
TB1-4	Channel two (+) Thermocouple, (blue) connection.

2800/4800 Main Board Terminal Block #1 (Version I & II)

Terminal	Definition
TB1-1	Channel one (+) Thermocouple, (blue) connection.
TB1-2	Channel one (-) Thermocouple, (red) connection.
TB1-3	Not Used (Ambient Compensator)
TB1-4	Channel two (-) Thermocouple, (red) connection.
TB1-5	Channel two (+) Thermocouple, (blue) connection.

2800/4800 Main Board Terminal Block #2 (All Versions)

Terminal	Definition
TB2-1	Refrigeration Machinery Enable output. This signal will be activated when the refrigeration machinery is required.
TB2-2	Channel One Alarm output. This signal will be activated when channel one is in alarm, either process or deviation.
TB2-3	Signal Common.
TB2-4	Auxiliary output #4. This signal will be on when Auxiliary output #4 (4800 Group 1) is selected.
TB2-5	Auxiliary output #3. This signal will be on when Auxiliary output #3 (4800 Group 1) is selected.
TB2-6	Auxiliary output #2. This signal will be on when Auxiliary output #2 (4800 Group 1) is selected.
TB2-7	Auxiliary output #1. This signal will be on when Auxiliary output #1 (4800 Group 1) is selected.
TB2-8	Signal Common.

TB2-9	Channel Two Alarm output. This signal will be activated when channel two is in alarm, either process or deviation.
TB2-10	Humidity System Enable output. This signal will be activated when the Humidity System is required.
TB2-11	Signal Common.
TB2-12	System Enable output. This signal will be activated when the 2800/4800 is in the RUN mode (either Program or Manual).
TB2-13	Auxiliary Cooling Output. This signal will be activated (pulse) when auxiliary cooling is required.
TB2-14	External Keyboard Lockout Input. This input will lock the 2800/4800 function keys when brought to a low state (less than 0.7V)
TB2-15	Dual Humidity system select Input. This input will select the analog %RH input when brought to a low state.
TB2-16	Signal Common.

2800/4800 Main Board Terminal Blocks #3 & #4 (All Versions)

Terminal	Definition
TB3-1	Heat Control Time Proportion Output. This output will pulse the Heat Control in proportion to the heat throttle. (2800 use only)
TB3-2	Signal Common for TB3-1 above.
TB4-1	Humidity Control Time Proportion Output. This output will pulse the Humidity Control in proportion to the humidity throttle. (2800 use only) This signal was also used as the refrigeration machinery enable output on 2800 only units when used on S1.2 model chambers.
TB4-2	Signal Common for TB4-1 above.

2800/4800 Main Board Terminal Block #5 (All Versions)

Terminal	Definition
TB5-1(G)	115 VAC Power Supply Earth Ground Connection.
TB5-2(N)	115 VAC Power Supply Neutral Connection.
TB5-3(L)	115 VAC Power Supply Line Connection.

4800 Function Board Terminal Block #1

Terminal	Definition
TB1-1	External RUN Input. The 4800 will go to the RUN mode, if it was in the HOLD mode, when this signal is brought low (less than 0.7V)
TB1-2	External STOP Input. The 4800 will go to the STOP mode, if it was in the RUN MANUAL or RUN PROGRAM mode, when this signal is brought low (less than 0.7V)

TB1-3	External HOLD Input. The 4800 will go to the HOLD mode, if it was in the RUN PROGRAM mode, when this signal is brought low (less than 0.7V)
TB1-4	External RESTART Input. The 4800 will attempt to RUN Program #1, Interval #1, when this signal is brought low (less than 0.7V). The 4800 must be in STOP, and Program #1 must exist.
TB1-5	External Print Trigger Input. The 4800 will cause a data to be sent to the external printer when this signal is brought low.
TB1-6	Signal Common for the above Input signals.

4800 Function Board Terminal Blocks #2 & #3.

Terminal	Definition
TB2-1	Voltage output for Analog Output #3. Note that jumper W1 must also be in the 'V' position.
TB2-2	Current output for Analog Output #3. Note that jumper W1 must also be in the 'I' position.
TB2-3	Signal Common for Analog Output #3.
TB3-1	Voltage output for Analog Output #4. Note that jumper W1 must also be in the 'V' position.
TB3-2	Current output for Analog Output #4. Note that jumper W1 must also be in the 'I' position.
TB3-3	Signal Common for Analog Output #4.

4800 Function Board Terminal Block #4.

Terminal	Definition
TB4-1	Analog (+) Input for channel two.
TB4-2	Analog (-) Input for channel two.
TB4-3	Analog (+) Input for channel three.
TB4-4	Analog (-) Input for channel three.

Multi-Option Board Terminal Blocks #1 & #2.

Terminal	Definition
TB1-1	Analog Output #2 (+) connection.
TB1-2	Analog Output #2 (-) connection.
TB2-1	Analog Output #1 (+) connection.
TB2-2	Analog Output #1 (-) connection.

Relay Board(s) Terminal Blocks #1, #2, & #3.	
Terminal	**Definition**
TB1-1 thru 8	SSR control voltage signal which corresponds to SSR's 1 thru 8.
TB2-1,2,3	115 VAC wiring terminals for SSR #1. Note that terminals TB2-2 and TB2-3 are the same.
TB2-4,5,6	115 VAC terminals for SSR #2
TB2-7,8,9	115 VAC terminals for SSR #3
TB2-10,11,12	115 VAC terminals for SSR #4
TB3-1,2,3	115 VAC terminals for SSR #5
TB3-4,5,6	115 VAC terminals for SSR #6
TB3-7,8,9	115 VAC terminals for SSR #7
TB3-10,11,12	115 VAC terminals for SSR #8

C.2 Relay Board SSR Assignments

The following table shows the SSR assignments based on the 2800/4800 system connector which is the source for that Relay Board.

SSR DESIGNATION TABLE

4800 BOARD					2800/4800 MAIN BOARD	
J1		J2	J3	J4	J3	
AUX1	AUX GRP 2	SYSTEM EVENT 1	HIGH HEAT CH. 1	HIGH HEAT CH. 2	AUX1	AUX GRP 1
AUX2		SYSTEM EVENT 2	LOW HEAT CH.1	LOW HEAT CH.2	AUX2	
AUX3		SYSTEM EVENT 3	LOW COOL CH. 1	LOW COOL CH. 2	AUX3	
AUX4		SYSTEM EVENT 4	HIGH COOL CH. 1	HIGH COOL CH. 2	AUX4	
AUX1	AUX GRP 3	SYSTEM EVENT 5	BY PASS CH. 1	BY PASS H. 2	SYSTEM ENABLE	
AUX2			COMP. ENABLE CH. 1	COMP. ENABLE CH. 2	REFRIG. ON*	
AUX3		DEV. ALARM CH. 3	DEV ALARM CH. 1	DEV ALARM CH. 2	HUM.* ENABLE	
AUX4		PROC. ALARM CH. 3	PROC. ALARM CH. 1	PROC. ALARM CH. 2	AUX COOL	

D. APPENDIX D - STOP CODES

D.1 General Description.

The 2800/4800 can provide the user with the reason why the unit is in the stop mode. This may be useful in trouble shooting the symptom 'Goes into STOP'. To view the last stop code, press the **STOP** key while the 2800/4800 is in the STOP mode. The 2800/4800 alpha display shows"

STOP CODE

and a number in the numeric display. Use the following table to interpret the meaning of the Stop Code.

CODE	MEANING
0	Not in STOP mode, or 2800/4800 has not run since RAM Test. May be caused by external EMI/RFI. See Appendix F for noise immunization procedures.
1	STOP key pressed while running. Normal stop code.
2	RAM Failure. The 2800/4800 is constantly checking program storage memory, if it detects an error then the unit is placed in stop. This may have been caused by external EMI/RFI. See Appendix F for noise immunization procedures.
3	Open T/C on channel one. Check thermocouple and connections. See Symptoms/Solutions.
4	Open T/C on channel two. See #3.
5	Temperature limit for 3.5 cu.ft. benchtop model exceeded. (115°C.)
6	Channel one variable exceeded process alarm settings. Check alarm settings.
7	Channel two variable exceeded process alarm settings. Check alarm settings.
8	Computer I/O Stop command (S) was received.
9	Test Complete, End of users profile. Normal stop code.
10	Channel three variable exceeded process alarm settings. Check alarm settings.
11	External STOP Input (from 4800 Function Board).
12	Open Analog Input on channel two (4800 Function Board).
13	Open Analog Input on channel three (4800 Function Board).
14	Analog-to-Digital Watch Dog time-out. Implies failure of A-to-D convertor. Replace 4800 Function Board.
15	Stop command from system Monitor Input (from 4800 Function Board).
16	Computer I/O Initialize command, which places the 2800/4800 in STOP mode.
17	Loss of Digital Altitude Transducer RS-232 communications.
18	Stop Command received from Master unit over master/slave RS-232 interface. (Slave device only).
19	Slave unit loss of communications. (Slave device only).
98	Internal Failure, contact Thermotron Product Support. (Stack Overflow)
99	Internal Failure, contact Thermotron Product Support. (Watch Dog Time-out)

E. APPENDIX E - CONFIGURATION

E.1 General Description

The 2800/4800 may be applied to many different chamber control applications. This is accomplished thru the use of configuration data which instructs the 2800/4800 to perform the required tasks for the chamber being controlled. The configuration data is usually hidden from the user, therefore, a special procedure is used to allow entry to the configuration routine.

E.2 Configuration Entry

The configuration entry procedure is described as follows:

1. Perform the Manual Reset procedure listed in Appendix A.

2. While the 2800/4800 is in the reset condition, press and hold the **SETUP** key. The 2800/4800 alpha display shows:

   CONFIGURE

3. Press the hidden **X** key. The 2800/4800 alpha display shows:

   OPTIONS

4. Press the **ENT** key. The 2800/4800 alpha display shows:

   2800

   or

   4800

   depending on the current selection. The 2800/4800 is now ready to accept configuration data.

E.3 Configuration Data

The configuration data may be obtained from the Configuration Data Sheet found in the users manual. A sample sheet is included here.

There are two methods of entering data in the configuration routines. These are explained as follows:

1. Toggle/Selection:
   When the 2800/4800 numeric display shows:

   ----

   it is using the toggle/selection method of data entry. The users presses the CLR key to toggle the data in the alpha display. When the desired data is shown in the alpha display, the user presses the **ENT** key to select that data.

2. Numeric Entry:
   When the 2800/4800 numeric displays shows numeric data, it is using the Numeric Entry method. The user will enter the required data using the numeric entry keys, and press the **ENT** key when the desired number is complete.

F. APPENDIX F - ELECTRICAL NOISE AND IMMUNIZATION PROCEDURES

F.1 General Description.

Electrical noise, commonly referred to as Electromagnetic Interference, (EMI), and Radio Frequency Interference, (RFI), consists of electro-magnetic induction and radiation which has the capability of causing interference with electronic circuitry. This interference will sometimes cause electronic equipment to malfunction to some degree. Failures related to EMI/RFI are often hard to identify, being of an intermittent and non-repeatable nature. It is very important to eliminate or minimize the sources of EMI/RFI, and/or to protect electronic equipment subject to them from their effects. The following procedures will assist the user in achieving this goal.

F.2 Sources of EMI/RFI

The following list identifies some of the sources of EMI/RFI. Once the sources have been identified, the user may apply the necessary noise reduction techniques to minimize the noise at the source.

1. Electrical Equipment such as: motors, contactors, and solenoids.

2. RFI generating Equipment such as radio transmitters.

F.3 Noise Immunization Procedures

The primary method of entry for EMI/RFI is thru electro-magnetic induction into the wires and cables connected to the electronic equipment. Once the EMI/RFI noise has been minimized wherever possible, the next step is to prevent whatever is left from entering the circuitry. This may be achieved thru the following methods:

1. Location: The physical location of the cables will determine the amount of the EMI/RFI inducted into those cables. Generally, the greater the distance between the electronic cables and the wiring containing the noise source, the lesser the effects on the electronics.

2. Shielding: All wires and cables must be shielded to minimize the induction of the noise into the cables. The shields must be terminated to earth ground on at least on end, and the termination method must not present a high impedance to high frequency energy. This is accomplished in part by making the shield drain wires as short as possible.

3. Ferrite Beads: These are used on the signal wires connected to the electronic circuitry to present an impedance 'bump' to high frequency noise which may have been induced in the wires. To be effective, the wire(s) should be passed thru the bead at least two times. NOTE: Do not pass the shield thru the ferrite bead.

A special consideration should be given to computer interface cables which connect to the 2800/4800. These cables often run outside the chamber control panel environment, and may be subject to increased levels of EMI/RFI. The user must ensure that these cables in particular are shielded, and the shield drains are terminated correctly. It has been our experience that in the case of GPIB cables, those with full metal shell connectors typically provide a better shield that the plastic shell variety. These cables are recommended for use on the 2800/4800 system.

G. APPENDIX G 4800 COMMON COMPUTER I/O PROBLEMS AND QUESTIONS

G.1 General Description

The following problems and questions are commonly asked about implementation of the Computer I/O Option for the 4800. This section provides answers to these questions to assist the user in accomplishing the task of interfacing with the 4800. These questions and answers should be reviewed. Even though the user may not have the specific problem mentioned, they will still provide valuable information.

These problems are divided into the following groups:

1. Not able to communicate at all.
2. Can send commands, but can not receive data.
3. Receives some data from the 4800, but it is wrong or garbled.
4. Can send and receive, but have problems with some specific commands.

It is recommended that the 4800 communications package be combined with the user application program in a mock-up system, before installation into the Host Computer. A mock-up system is defined as a dumb terminal. An example of a dumb terminal would be a Terminal Emulation Program (RS-232 applications) or an "IBIC" program (GPIB applications). Using a mock-up allows the user to become familiar with the 4800 command syntax and data formats. It is also easier to troubleshoot any problems when operating in that mode.

4800 AND HOSTCOMPUTER DO NOT COMMUNICATE AT ALL

Often caused by improper interconnections or wiring. First, check the wiring and interconnections between the Host Computer and 4800. A breakout box or bus analyzer is the recommended testing device.

RS-232	*Check for proper line connections. Check for proper pin connections. Review the signal line descriptions for the 4800 and Host Computer.*
GPIB	*Check that all cable connections are tight. Do not rule out a faulty cable.*

The secon most common cause is invalid interface parameters. Check that the Host Computer and 4800 are using the same interface parameters. Refer to Section x for the description and setting of the DIP switch on the Computer I/O Option board. Remember, the 4800 must be reset before it will use the new switch settings. Reset the 4800 either through a Power Cycle or Manual Reset.

RS-232	*Check the settings of the baud, bits per character, parity, handshake etc.*
GPIB	*Check the address selection. Remember, each instrument on the bus must have a unique address in the range of 0 to 30. Also, when setting the address of the 4800, remember that the individual switches apply their weighted value when they are in the off position.*

4800 RECEIVES COMMANDS, BUT DOES NOT TRANSMIT DAT

This problem indicates that the computer interface or handshake signal is improperly set up.

TERMINATOR

The most common problem related to this symptom is the 4800 and Host Computer are not using the same terminating charater or sequence. Refer to section x for setting these signals. When the 4800 is receiving command strings, it uses any of the legal terminators to identify the end of a command string. Most computers are not as flexible when it comes to receiving data from the 4800. For this reason, the 4800 has selectable terminating characters or sequences. Ensure that the 4800 and Host Computer agree on the selected one.

HANDSHAKE PROBLEM

When using RS-232, lack of handshaking may cause this problem. The 4800 identifies a busy signal being received from the Host Computer and will not transmit data. Refer to Section x for a description and settings for SW6 on the x board. If reseting the switch does not solve the problem, disconnect the handshake input lines (pins 4 and 20) between the 4800 and the Host Computer. Set SW6 to ON (low handshaking polarity). This implies that the Host Computer ready for data. The 4800 will send the requested data as soon as it receives the Dump command.

HOST COMPUTER RECEIVES SOME DATA FROM 4800, BUT IT IS WRONG OR GARBLED

Wrong or garbled data is commonly caused by improper use of command sequences or by entering the improper communication parameters.

BUFFER OUT OF SYNCH

This symptom usually results from the 4800 having excess data in its output buffer. This typically occurs when the computer does not read all the data it has asked for.

The problem is usually corrected by using the Clear Buffer (CB) command concatenated before every Dump command. This causes the 4800 to clear any characters in its output buffer. Once the buffer is clear, the data is loaded.

PARAMETER MISMATCH

This symptom usually results from a mismatch in the RS-232 communication parameters such as baud or bit per characte. It is recommended to check these parameters.

PROBLEMS WITH SPECIFIC COMMANDS

Some commands may cause problems when they are not in the proper manner or sequence. A useful aid in troubleshooting these types of problems are the error codes. Using the DEC command, hese error codes are downloaded from the 4800 for user review.

If a Load commands is not accepted, check the data sent with the command. Determine is the range of the data is acceptable to the 4800 for that command. For example, sending the command 'L2S-10' is not acceptable since channel 2 is aRelative Humidity channel.
Some Load commands require that data be sent as a decimal representation of a binary number. These include the Load Auxiliary command, Load SRQ Mask Command, etc. For example, to turn Auxiliary Outputs 1, and 3 on (binary 0101), the correct command is 'LAX 5'. Binary 0101 equals decimal 5. Similarly, some Dump commands send binary data which requires decoding to a decimal value.

If the LPM and LPI commands cause problems, check to insure that that interval 0 is being sent. Also, when loading by value, the data fields are position dependant. Commas are required to maintain correct position.

H. APPENDIX H - BOARD REPLACEMENT PROCEDURES

H.1 General Instructions

Follow the procedures in this Appendix whenever replacing one of the boards in the 2800/4800 system. The following instruction apply to any board replacement.

1. Refer to the desired board replacement procedure for any preliminary instructions.
2. Remove power from the 2800/4800 system.
3. Identify the board being replaced.
4. Remove any boards mounted on top of the identified board. Mark and record the location of all wire and cable connectors.
5. Replace the identified board. Re-connect all wires and cables to their proper connectors.
6. Apply power to the 2800/4800 system.
7. Read and follow the special replacement instructions for the exchanged board. Refer to the figures found in the functional description section to locate any components referenced in the replacement instructions.

H.2 MAIN BOARD

The following special instructions apply to the replacement of the Main Board.

1. Before removing power from the 2800/4800 system, compare the configuration data found in the instruction manual with the data in the 2800/4800. If the data is not in the manual, record the configuration data on the sheet provided. See Appendix E.
2. Record the control parameters for the 2800/4800, found under the ARAM key.
3. Replace the Main Board, following the steps under General Instructions above. Be sure to use a Main Board with the correct number of input channels, 1 or 2. A 2 channel unit may be used to replace a 1 channel unit, however, the thermocouple input for channel two must be jumpered at terminal block TB1.
4. Enter the configuration mode, and check and update configuration data. See Appendix E.
5. Enter the control parameters recorded in step 2.
6. Check calibration of Thermocouple inputs, and re-calibrate as required. See instruction manual.
7. Recalibrate all Analog Outputs. See instruction manual.
8. Check the position of jumper W1, (W3 on Version I Main Boards). This jumper should be in the STD position (pos 1) for all application except when the 2800/4800 is used on the model SM-3.5-S/C. If used on this model, place the jumper in the LOCK position (pos 2). All other jumpers (if any) should be in the '1' position.

H.3 DISPLAY HEAD

The following special instructions apply to the replacement of the Display Head.

1. Replace Display Head.
2. Perform Display test and Keyboard test on new Display Head. See Appendix A.

H.4 4800 FUNCTION BOARD

The following special instructions apply to the replacement of the 4800 Function Board.

1. Refer to and follow the general instructions above.
2. When installing the replacement 4800 Function Board, ensure that the pins of connector J6 mate correctly with J4 on the Main Board.
3. Set jumpers W1 thru W4 in the same positions as the board being replaced.
4. Calibrate Analog Outputs #3 and #4. See instruction manual.

H.5 MULTI- OPTION BOARD

The following special instructions apply to the replacement of the Multi-Option board.

1. Refer to and follow the general instructions above.
2. Calibrate Analog Outputs #3 and #4. See instruction manual.
3. Set Real Time Clock. See instruction manual.

H.6 COMPUTER INTERFACE BOARD (GPIB or RS-232)

The following special instructions apply to the replacement of the Computer Interface board.

1. Refer to and follow the general instructions above.
2. Set switches 1 thru 8 on DIP switch SW1 identical to those on board being replaced, or see instruction manual for switch settings.

I APPENDIX I - ASSEMBLY COMPUTER NUMBERS

MAIN BOARD

Assembly	C/N (1ch)	C/N (2ch)
2800 Only	707155	705977
2800/4800 Ver I	733407	731226
2800/4800 Ver II (Rev 'E' PCB)	799440	799459
2800/4800 Ver II (Rev 'F' PCB)	827037	827045

DISPLAY HEAD

Assembly	C/N (2800)	C/N (4800)
Version I	705958	718963
Version II	753726	751456
Version III	822817	822825

4800 FUNCTION BOARD

Assembly	C/N (1ch)
4800 Function Board (with Analog Input)	718912
4800 Function Board (without Analog Input)	790796

MULTI OPTION BOARD

Assembly	C/N
Version I	707163
Version II	815160

COMPUTER INTERFACE OPTION BOARDS

Assembly	C/N (RS-232)	C/N (GPIB)
Version I(A)	705969	705950
Version I(B)	733717	733725
Version II (Rev F,G PCB's)	812838	812846
Version II (Rev H PCB)	840653	843172

RELAY BOARDS

Assembly	c/n
8-position	799424
4-position	838543

REMOTE EEROM ASSEMBLY

Assembly	C/N
Complete Assembly (includes 19" panel)	765023
PCB assembly only	751847

CABLES

Assembly	Length	C/N
Display Head	1.5 ft.	819794
or RS-232	6 ft.	820148
or Newport Print.	10 ft.	820156
Printer (Memodyne)	1.5 ft.	819816
	6 ft.	820164
	10 ft.	820172
To Relay Board	1 ft.	780464
	2 ft.	780472
	4 ft.	749540
	6 ft.	749559
	12 ft.	749567
Option Bd. Cable	3-position	717916
	4-position	732419
GPIB Cables	0.5 M	827347
	1.0 M	831778
	2.0 M	831786
	4.0 M	831794
Remote EEROM	4 ft.	760919

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Our environmental simulation equipment and systems are designed to provide many years of dependable service. But for maximum efficiency at all times, each system must be properly maintained and serviced.

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- Increased efficiency with maintenance performed according to your schedule.
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- Improved use of funds with less of your money invested in spare parts inventory.
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For further information about our Preventive Maintenance Agreement and how it can benefit the operation of your plant, call us — (616) 392-1491.

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25070	YELLOW
25071	BLACK
25072	LIGHT BLUE
25073	DARK BLUE
25074	LIGHT GRAY
25075	LIGHT GREEN
25076	DARK GREEN
25077	TANGERINE
25078	RED
25079	EXECUTIVE RED

GENUINE PRESSBOARD

ACCO INTERNATIONAL INC
CHICAGO, ILLINOIS 60618